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PATENT ABSTRACTS OF JAPAN

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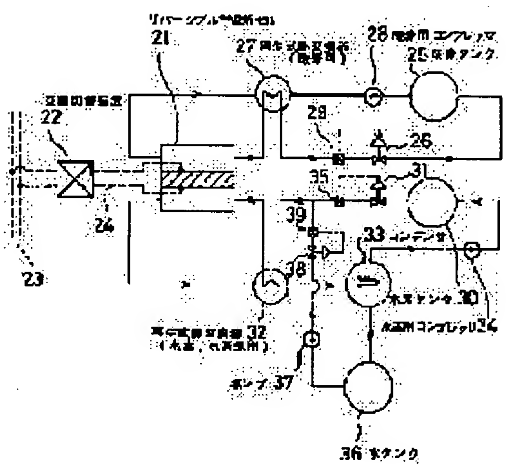
(54) POWER STORING DEVICE

(57)Abstract:
PURPOSE: To improve the operability in electrolysis and generation by setting the flowing direction of hydrogen or oxygen and steam supplied to steam electrolysis at electrolysis and generation in a fixed direction.
CONSTITUTION: In electrolytic operation, water is sent from a water tank 36 by a pump 37, mixed with a small quantity of hydrogen in the course of a hydrogen line, and supplied to a reversible electrolytic cell 21. The hydrogen manufactured by the electrolytic cell 21 and the unreacted steam are discharged from the outlet port of the electrolytic cell 21, the steam is condensed by a condenser 33 and separated into hydrogen and water. The hydrogen is pressurized by a compressor 34 and returned to a hydrogen tank 30. On the other hand, oxygen system is supplied to the electrolytic cell 21 in a fixed flow rate. The flow rate is increased in the electrolytic cell 21 outlet port at electrolysis, and the flow rate is reduced in the cell 21 outlet port lower than in the inlet port at generation. Thus, in both electrolytic mode and generating mode, hydrogen, oxygen and steam absolutely follow the same route.



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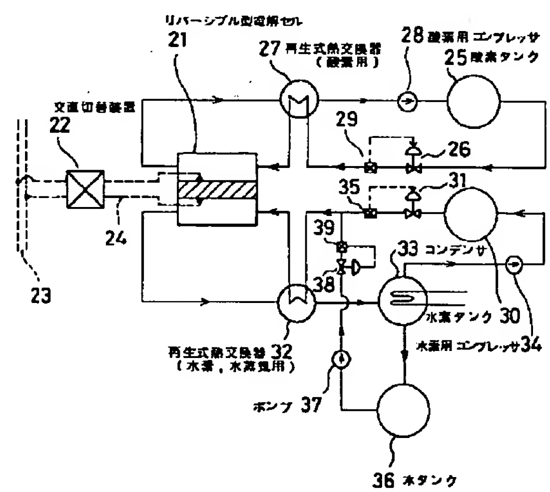
最終頁に続く

(54)【発明の名称】　電力貯蔵装置

(57)【要約】

【目的】電解時および発電時における操作性が優れ、かつ信頼性の高い水素利用型の電力貯蔵装置を提供することを目的とする。

【構成】固体酸化物電解質を備えた水蒸気電気分解セル２１によって水蒸気から水素および酸素を製造し、これらガスを一時的に貯蔵し、前記水蒸気電気分解セル２１に再び前記水素および酸素を逆流させて発電を行う電力貯蔵装置において、電気分解時および発電時に前記水蒸気電気分解に供給する水素または酸素および水蒸気の流れ方向を一定方向にしたことを特徴としている。



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【特許請求の範囲】

【請求項1】　固体酸化物電解質を備えた水蒸気電気分解セルによって水蒸気から水素および酸素を製造し、これらガスを一時的に貯蔵し、前記水蒸気電気分解セルに再び前記水素および酸素を逆流させて発電を行う電力貯蔵装置において、電気分解時および発電時に前記水蒸気電気分解に供給する水素または酸素および水蒸気の流れ方向を一定方向にしたことを特徴とする電力貯蔵装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、夜間の余剰電力を利用する電力貯蔵装置に関する。

【0002】

【従来の技術】電力貯蔵装置は、電力消費の日中と夜間の格差が著しい場合、発電設備、例えば原子力発電所の有効利用のために夜間に余剰となる電力を貯蔵し、日中に放電してピーク負荷に対応するものである。

【0003】最も代表的な電力貯蔵装置は、揚水発電所であるが、図2に示すように夜間電力で水もしくは水蒸気を電気分解して燃料になる水素を製造し、貯蔵し、電力を必要とするときに、前記水素を燃料とする燃料電池で発電する装置である。すなわち、水素を媒体とする電力貯蔵装置では図2に示すようにリバーシブル型電解セル1で電気分解して水素および酸素を製造し、それぞれのガスを水素タンク2および酸素タング3に貯蔵する。この時、水は水素および酸素によって加熱されて前記電解セル1に入る。発電時には、前記水素および酸素を前記タンク2、3から逆流させて前記リバーシブル型電解セル1に導入し、前記電解セル1を逆作動させて燃料電池として発電する。この時、水素は再生熱交換器4ａ、4ｂにおいて水蒸気と熱交換され、酸素は再生熱交換器5ａ、5ｂにおいて水蒸気と熱交換され、それぞれ高温の水素、酸素となって前記電解セル1に流入される。生成された水蒸気は、電気分解時の流れと逆方向になって水タンク6へ戻される。なお、図2は自立型であり、最初の立ち上げ運転に用いられる加熱源は省略されている。また、図2中の7は水素用コンプレッサ、8は酸素用コンプレッサ、9はポンプ、10は交直切替装置、11は交流幹線である。

【0004】

【発明が解決しようとする課題】しかしながら、前述した電力貯蔵装置は次のような問題があった。

【0005】（1）電解時と発電時とでは流れが逆転するため前記電解セルの出入口が電解時と発電時に逆になり、電解と発電の切替え操作時に各部の温度が変化する。この時、温度変化によって前記電解セルに繰り返しの熱応力が作用するため電解セルの健全性が損なわれる。

【0006】（2）再生式熱交換器において、切替操作時（2回／日の短期切替）に熱の移動方向が変化するため、熱交換器に温度変化が起こり、繰り返しの熱応力が作用し、熱交換器の健全性が損なわれる。

（3）電解と発電の切替毎にポンプの起動停止、弁の開閉操作が必要になるため、繁雑な操作を強いられる。

【0007】本発明は、上記従来の問題点を解決するためになされたもので、電解時および発電時における操作性が優れ、かつ信頼性の高い水素利用型の電力貯蔵装置を提供しようとするものである。

【0008】

【課題を解決するための手段】本発明は、固体酸化物電解質を備えた水蒸気電気分解セルによって水蒸気から水素および酸素を製造し、これらガスを一時的に貯蔵し、前記水蒸気電気分解セルに再び前記水素および酸素を逆流させて発電を行う電力貯蔵装置において、電気分解時および発電時に前記水蒸気電気分解に供給する水素または酸素および水蒸気の流れ方向を一定方向にしたことを特徴とする電力貯蔵装置である。本発明に係わる電力貯蔵装置は、具体的には以下に示す構造になっている。

【0009】（1）酸素の系統は、酸素タンクから酸素が流量調節弁、再生式熱交換器を経てリバーシブル型電解セルに入り、前記電解セル出口から再生式熱交換器を経て酸素用コンプレッサで回流する酸素を加圧して酸素タンクに戻す一巡式を採用した。

【0010】（2）水素の系統は、水素タンクから水素が流量調節弁、再生式熱交換器を経てリバーシブル型電解セルに入り、前記電解セル出口から再生式熱交換器を経てコンデンサに至り、水素用コンプレッサで加圧して水素タンクに戻す一巡式を採用した。

【0011】（3）水蒸気の系統は、水タンクから水がポンプ、流量調節弁を経て水素ラインと合流し再生式熱交換器で水を蒸発させ、水蒸気として電解セルに送る。未反応の水蒸気は再生式熱交換器を経てコンデンサに至り、ここで凝縮水として水タンクに戻す一巡式を採用した。

【0012】

【作用】このような構成の電力貯蔵装置によれば、水素、酸素、水／水蒸気の系統をそれぞれ一巡方式にすることによって、電気分解運転から発電運転モード切替においても、流れの向きが変わらず、水ポンプ、コンプレッサも運転を維持したままにできる。すなわち、電気分解運転においては水タンクからポンプで水が送られ、途中で少量の水素と混合して電解セルへ供給され、電解セルで製造された水素と未反応の水蒸気が電解セル出口より排出され、コンデンサで水蒸気が凝縮され、水素と水に分離される。水素は、コンプレッサで加圧されて水素タンクに戻されて貯蔵され、水は水タンクに戻される。

【0013】また、発電運転においては水素タンクから流量調節弁を経て水素が途中で少量の水と混合して電解セルへ供給され、電池反応によって製造された水蒸気と未反応の水素を伴って電解セル出口より排出され、コン

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デンサで水蒸気が凝縮され、水は水タンクに、水素は水素タンクにそれぞれ戻される。このように電解時および発電時においても全く同じ経路を辿る。

【0014】一方、酸素系は電解および発電に無関係に一定流量で電解セルに供給され、電解時には前記電解セル出口で流量が増加し、発電時には前記電解セル出口流量が入口より減少する。

【0015】したがって、本発明の電力貯蔵装置によれば切替による操作は電源部の送受電切替と、水素流量、水流量の調節のみですむため、操作性が優れ、かつ信頼性を著しく高めることができる。

【0016】

【実施例】以下、本発明の実施例を図1を参照して詳細に説明する。

【0017】図1は、本発明の電力貯蔵装置の系統図である。図中の２１はリバーシブル型電解セルであり、水蒸気電気分解と燃料電池の両方の機能を有する。前記電解セル２１は、電解質として安定化ジルコニアが使用され、かつ前記電解質の両面には多孔質電極（例えば白金）が取り付けられた構造になっている。前記電解セル２１は、直交切替装置２２を経て交流２３を直流２４に変換した電気を前記電解セル２１の電極間に通電することによって水蒸気を水素と酸素に分解する。また、逆に前記電解セル２１に水素と酸素とを供給することによって直流を発生し、前記直流は前記直交切替装置２２を経て交流に変換されて送電される。

【0018】酸素の系統は、酸素タンク２５から酸素が流量調節弁２６、酸素用再生式熱交換器２７を経て前記電解セル２１に入り、前記電解セル２１出口から前記再生式熱交換器２７を経て酸素用コンプレッサ２８で回流する酸素を加圧して前記酸素タンク２５に戻す一巡式になっている。前記流量調節弁２６は、酸素ラインに配置された規定した流量計２９の信号によりフィードバック制御される。また、前記酸素用コンプレッサ２８は、還流した酸素を前記酸素タンク２５に押し込むものである。

【0019】水素の系統は、水素タンク３０から水素が流量調節弁３１、水素、水蒸気用の再生式熱交換器３２を経て前記電解セル２１に入り、前記電解セル２１出口から前記再生式熱交換器３２を経てコンデンサ３３に至り、水素用コンプレッサ３４で加圧して前記水素タンク３０に戻す一巡式になっている。前記流量調節弁３１は、水素ラインに配置された規定した流量計３５の信号によりフィードバック制御される。また、前記コンデンサ３３は水素と水蒸気の混合基体を冷却して水蒸気は水にして水素を分離するものである。前記水素用コンプレッサ３４は、還流した水素を前記水素タンク３０に押し込むものである。

【0020】水蒸気の系統は、水タンク３６から水がポンプ３７、流量調節弁３８を経て前記水素ラインと合流し、前記再生式熱交換器３２で水を蒸発させ、水蒸気として前記電解セル２１に送る。未反応の水蒸気は前記再生式熱交換器３２を経て前記コンデンサ３３に至り、ここで凝縮水として前記水タンク３６に戻す一巡式になっている。前記流量調節弁３８は、水ラインに配置された規定した流量計３９の信号によりフィードバック制御される。

【0021】なお、前記各再生式熱交換器２７、３２は一般に前記電解セル２１が８００～１０００℃で運転されるため、前記電解セル２１へ供給する水素、水蒸気、酸素をそれぞれの排気（８００～１０００℃）と熱交換して加熱するものである。

【0022】このような構成によれば、電気分解運転においては水タンク３６からポンプ３７で水が送られ、水素ラインの途中で少量の水素と混合してリバーシブル型電解セル２１へ供給され、前記電解セル２１で製造された水素と未反応の水蒸気が前記電解セル２１出口より排出され、コンデンサで水蒸気が凝縮され、水素と水に分離される。水素は、コンプレッサ３４で加圧されて水素タンク３０に戻されて貯蔵され、水は水タンク３６に戻される。かかる電解運転は、流量調節弁２６、３１、３８を制御することによって、例えばモル比で水素１：酸素０．５：水１０以上（キャリアが９占める）の条件で行われる。

【0023】また、発電運転においては前記水素タンク３０から流量調節弁３１を経て水素が途中で少量の水と混合して前記電解セル２１へ供給され、電池反応によって製造された水蒸気と未反応の水素を伴って前記電解セル２１出口より排出され、コンデンサ３３で水蒸気が凝縮され、水は水タンク３６に、水素は水素タンク３０にそれぞれ戻される。かかる発電運転は、流量調節弁２６、３１、３８を制御することによって、例えばモル比で水素１（キャリアが０．９占める）：酸素０．５：水０．２の条件で行われる。

【0024】一方、酸素系は電解および発電に無関係に一定流量で前記電解セル２１に供給され、電解時には前記電解セル２１出口で流量が増加し、発電時には前記電解セル２１出口流量が入口より減少する。

【0025】したがって、電解モードおよび発電モードを共に水素、酸素、水蒸気は全く同じ経路を辿り、それらの流れ方向が変わらないため切替による操作は電源部の送受電切替と、水素流量、水流量の調節のみですむ。その結果、運転が容易で運転要因の削減を図ることができると共に、信頼性を向上できる。

【0026】また、流れ方向が変化しないために常にシステムの最高温度位置を電解セル２１の出口側に存在させることができるため、再生式熱交換器２７、３２における伝熱温度差を一定に保つことができ、電解セル２１入口温度も最高温度とある一定の差に保持することができる。その結果、運転切替による電解セル２１の温度変

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化が生じず、繰り返し熱応力の発生がなく、耐久性の向上に寄与する。

【0027】同様に、再生式熱交換器２７、３２における最高温度点、最低温度点が運転切替に依存せずに固定できるため、温度変動による熱応力疲労を軽減でき、信頼性を向上できる。

【0028】

【発明の効果】以上詳述したように、本発明によれば操作性に優れ、運転が容易で運転要因の削減を図ることができると共に、繰り返し熱応力の発生および温度変動による熱応力疲労を軽減して信頼性の向上が図られた電力貯蔵装置を提供できる。

【図面の簡単な説明】

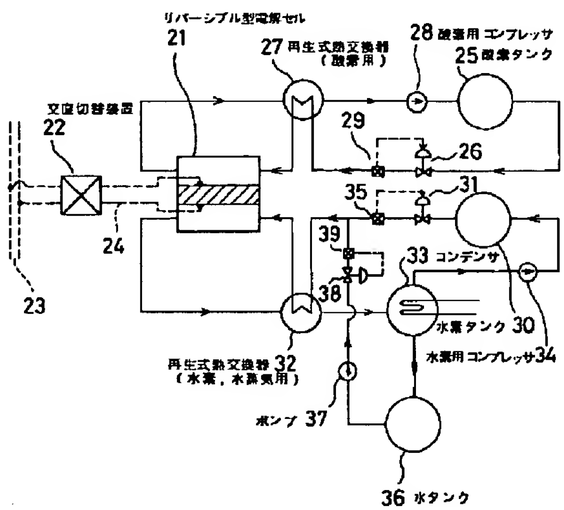
【図１】本発明の一実施例を示す電力貯蔵装置の系統図。

【図２】従来の電力貯蔵装置の系統図。

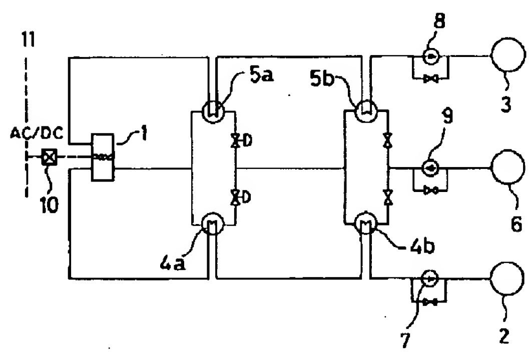
【符号の説明】

２１…リバーシブル型電解セル、２２…交直切替装置、２５…酸素タンク、２７…酸素用再生式熱交換器、２８…水素用コンプレッサ、３０…水素タンク、３２…水素、水蒸気用の再生式熱交換器、３３…コンデンサ、３４…水素用コンプレッサ、３６…水タンク、３７…ポンプ。

【図１】



【図２】



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CLAIMS

[Claim(s)]
[Claim 1] The power storage equipment characterized by to carry out the flow direction of the hydrogen supplied to the aforementioned steam electrolysis at the time of electrolysis and power generation or oxygen, and a steam in the fixed direction in the power storage equipment which manufactures hydrogen and oxygen from a steam, stores these gas temporarily, and generates electricity by the steam electrolysis cell equipped with the solid-acid ghost electrolyte by making the aforementioned hydrogen and oxygen flow backwards again in the aforementioned steam electrolysis cell.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the power storage equipment using the dump power of night.
[0002]
[Description of the Prior Art] When the gap of the daytime and night of power consumption is remarkable, power storage equipment stores the power which serves as a surplus at night for a power generation facility, for example, a deployment of a nuclear power station, discharges at daytime, and corresponds to a peak load.
[0003] Although the most typical power storage equipment is a pumped storage power station, when the hydrogen which electrolyzes water or a steam with power night, and becomes fuel is manufactured and stored as shown in drawing 2 and power is needed, it is equipment which generates the aforementioned hydrogen by the fuel cell used as fuel. That is, with the power storage equipment through hydrogen, as shown in drawing 2 , it electrolyzes by the reversible type electrolysis cell 1, and hydrogen and oxygen are manufactured, and each gas is stored in the hydrogen tank 2 and the oxygen tongue 3. At this time, water is heated by hydrogen and oxygen and goes into the aforementioned electrolysis cell 1. At the time of power generation, the aforementioned hydrogen and oxygen are made to flow backwards from the aforementioned tanks 2 and 3, it introduces into the aforementioned reversible type electrolysis cell 1, the reverse action of the aforementioned electrolysis cell 1 is carried out, and it generates electricity as a fuel cell. At this time, in the reproduction heat exchangers 4a and 4b, the heat exchange of the hydrogen is carried out to a steam, and in the reproduction heat exchangers 5a and 5b, the heat exchange of the oxygen is carried out to a steam, it turns into hot hydrogen and oxygen, respectively, and flows into the aforementioned electrolysis cell 1. The generated steam becomes the flow and opposite direction at the time of electrolysis, and is returned to a water tank 6. In addition, drawing 2 is a become [independent] type and the source of heating used for the first starting operation is omitted. Moreover, for the compressor for hydrogen, and 8, as for a pump and 10, the compressor for oxygen and 9 are [seven in drawing 2 / an AC/DC transfer device and 11] ac mains.
[0004]
[Problem(s) to be Solved by the Invention] However, the power storage equipment mentioned above had the following problems.
[0005] (1) In the time of electrolysis and power generation, since a flow is reversed, the entrance of the aforementioned electrolysis cell becomes reverse at the time of electrolysis and power generation, and the temperature of each part changes at the time of change operation of electrolysis and power generation. At this time, in order that the thermal stress of a repeat may act on the aforementioned electrolysis cell by the temperature change, the soundness of an electrolysis cell is spoiled.
[0006] (2) In a heat regenerator, since the move direction of heat changes at the time of change operation (two short-term [/day] change), a temperature change happens to a heat exchanger, the thermal stress of a repeat acts, and the soundness of a heat exchanger is spoiled.
(3) Since the switching operation of a Start-pump halt and a valve is needed for every change of electrolysis and power generation, it is forced complicated operation.
[0007] this invention was made in order to solve the above-mentioned conventional trouble, the operability at the time of electrolysis and power generation is excellent, and it tends to offer reliable hydrogen use type power storage equipment.
[0008]
[Means for Solving the Problem] this invention is power storage equipment characterized by to carry out the flow direction of the hydrogen supplied to the aforementioned steam electrolysis at the time of electrolysis and power generation or oxygen, and a steam in the fixed direction in the power storage equipment which manufactures hydrogen and oxygen from a steam, stores these gas temporarily, and generates electricity by the steam electrolysis cell equipped with the solid-acid ghost electrolyte by making the aforementioned hydrogen and oxygen flow backwards again in the aforementioned steam electrolysis cell. The power storage equipment concerning this invention specifically has structure shown below.
[0009] (1) Oxygen went into the reversible type electrolysis cell through the flow control valve and the heat regenerator from the oxygen tank, and a round formula which pressurizes the oxygen which carries out a time style by the compressor for oxygen through a heat regenerator from the aforementioned electrolysis-cell outlet, and is returned to an oxygen tank was used for the system of oxygen.
[0010] (2) Hydrogen went into the reversible type electrolysis cell through the flow control valve and the heat regenerator from the hydrogen tank, the system of hydrogen resulted [from the aforementioned electrolysis-cell outlet] in the capacitor through the

heat regenerator, and a round formula which pressurizes by the compressor for hydrogen and is returned to a hydrogen tank was used for it.
[0011] (3) Water joins a hydrogen line through a pump and a flow control valve from a water tank, and the system of a steam evaporates water in a heat regenerator, and send it to an electrolysis cell as a steam. The unreacted steam resulted in the capacitor through the heat regenerator, and adopted a round formula returned to a water tank as the water of condensation here.
[0012]
[Function] According to the power storage equipment of such composition, by making the system of hydrogen, oxygen, and a water/steam into a round method, respectively, in a generating-mode mode change, the flow direction does not change from electrolysis operation, but a water pump and a compressor also keep operation maintained. That is, in electrolysis operation, water is sent with a pump from a water tank, it mixes with a small amount of hydrogen on the way, an electrolysis cell is supplied, the hydrogen manufactured by the electrolysis cell and an unreacted steam are discharged from an electrolysis-cell outlet, a steam is condensed by the capacitor, and it separates into hydrogen and water. Hydrogen is pressurized by the compressor, and is returned and stored in a hydrogen tank, and water is returned to a water tank.
[0013] Moreover, in a generating mode, hydrogen is mixed with little water on the way through a flow control valve from a hydrogen tank, an electrolysis cell is supplied, it is discharged from an electrolysis-cell outlet with the steam manufactured by the cell reaction and unreacted hydrogen, and a steam is condensed by the capacitor, water is returned to a water tank and hydrogen is returned to a hydrogen tank, respectively. Thus, the completely same path is followed at the time of electrolysis and power generation.
[0014] On the other hand, an oxygen system is supplied to an electrolysis cell with constant flow regardless of electrolysis and power generation, a flow rate increases at the aforementioned electrolysis-cell outlet at the time of electrolysis, and the aforementioned electrolysis-cell outlet flow rate decreases from an entrance at the time of power generation.
[0015] Therefore, according to the power storage equipment of this invention, since the operation by change requires transmission-and-reception ****** of a power supply section, and only regulation of a hydrogen flow rate and the amount of streams, operability is excellent and it can raise reliability remarkably.
[0016]
[Example] Hereafter, the example of this invention is explained in detail with reference to drawing 1 .
[0017] Drawing 1 is the schematic diagram of the power storage equipment of this invention. 21 in drawing is a reversible type electrolysis cell, and has the function of both steam electrolysis and a fuel cell. The aforementioned electrolysis cell 21 has the structure where the stabilized zirconia was used as an electrolyte and the porous electrode (for example, platinum) was attached in both sides of the aforementioned electrolyte. The aforementioned electrolysis cell 21 disassembles a steam into hydrogen and oxygen by energizing the electrical and electric equipment which changed the alternating current 23 into direct current 24 through the rectangular transfer device 22 to inter-electrode [of the aforementioned electrolysis cell 21]. Moreover, by supplying hydrogen and oxygen to the aforementioned electrolysis cell 21 conversely, a direct current is generated, and the aforementioned direct current is changed and transmitted to an alternating current through the aforementioned rectangular transfer device 22.
[0018] Oxygen goes into the aforementioned electrolysis cell 21 through a flow control valve 26 and the heat regenerator 27 for oxygen from the oxygen tank 25, and the system of oxygen has become a round formula which pressurizes the oxygen which carries out a time style by the compressor 28 for oxygen through the aforementioned heat regenerator 27 from the electrolysis-cell 21 aforementioned outlet, and is returned to the aforementioned oxygen tank 25. Feedback control of the aforementioned flow control valve 26 is carried out by the signal of the specified flowmeter 29 which has been arranged at the oxygen line. Moreover, the aforementioned compressor 28 for oxygen stuffs the oxygen which flowed back into the aforementioned oxygen tank 25.
[0019] Hydrogen goes into the aforementioned electrolysis cell 21 through the heat regenerator 32 for a flow control valve 31, hydrogen, and steams from the hydrogen tank 30, and the system of hydrogen results [from the electrolysis-cell 21 aforementioned outlet] in a capacitor 33 through the aforementioned heat regenerator 32, and has become a round formula which pressurizes by the compressor 34 for hydrogen and is returned to the aforementioned hydrogen tank 30. Feedback control of the aforementioned flow control valve 31 is carried out by the signal of the specified flowmeter 35 which has been arranged at the hydrogen line. Moreover, the aforementioned capacitor 33 cools the mixed-base object of hydrogen and a steam, uses a steam as water and separates hydrogen. The aforementioned compressor 34 for hydrogen stuffs the hydrogen which flowed back into the aforementioned hydrogen tank 30.
[0020] Water joins the aforementioned hydrogen line through a pump 37 and a flow control valve 38 from a water tank 36, and the system of a steam evaporates water in the aforementioned heat regenerator 32, and is sent to the aforementioned electrolysis cell 21 as a steam. An unreacted steam results in the aforementioned capacitor 33 through the aforementioned heat regenerator 32, and has become a round formula returned to the aforementioned water tank 36 as the water of condensation here. Feedback control of the aforementioned flow control valve 38 is carried out by the signal of the specified flowmeter 39 which has been arranged at the water line.
[0021] In addition, since the aforementioned electrolysis cell 21 is generally operated at 800-1000 degrees C, each aforementioned heat regenerators 27 and 32 carry out the heat exchange of the hydrogen supplied to the aforementioned electrolysis cell 21, a steam, and the oxygen to each exhaust air (800-1000 degrees C), and heat them.
[0022] While being a hydrogen line, according to such composition, in electrolysis operation, water is sent with a pump 37 from a water tank 36, and it mixes with a small amount of hydrogen, and the reversible type electrolysis cell 21 is supplied, and the hydrogen manufactured by the aforementioned electrolysis cell 21 and an unreacted steam are discharged from the

electrolysis-cell 21 aforementioned outlet, a steam is condensed by the capacitor, and it separates into hydrogen and water. Hydrogen is pressurized by the compressor 34, and is returned and stored in the hydrogen tank 30, and water is returned to a water tank 36. This electrolysis operation is performed by ten or more (a carrier occupies nine) hydrogen 1:oxygen 0.5:water conditions by the mole ratio by controlling flow control valves 26, 31, and 38.

[0023] Moreover, in a generating mode, hydrogen is mixed with little water on the way through a flow control valve 31 from the aforementioned hydrogen tank 30, the aforementioned electrolysis cell 21 is supplied, it is discharged from the electrolysis-cell 21 aforementioned outlet with the steam manufactured by the cell reaction and unreacted hydrogen, and a steam is condensed by the capacitor 33, water is returned to a water tank 36 and hydrogen is returned to the hydrogen tank 30, respectively. This generating mode is performed on condition that hydrogen 1 (carrier occupies 0.9):oxygen 0.5:water 0.2 by the mole ratio by controlling flow control valves 26, 31, and 38.

[0024] On the other hand, an oxygen system is supplied to the aforementioned electrolysis cell 21 with constant flow regardless of electrolysis and power generation, a flow rate increases at the electrolysis-cell 21 aforementioned outlet at the time of electrolysis, and the aforementioned electrolysis-cell 21 outlet flow rate decreases from an entrance at the time of power generation.

[0025] Therefore, in order that both hydrogen, oxygen, and steams may follow the same path and may not change those flow directions at all in electrolysis mode and power generation mode, the operation by change requires transmission-and-reception ****** of a power supply section, and only regulation of a hydrogen flow rate and the amount of streams. Consequently, reliability can be improved, while operation is easy and can aim at curtailment of an operation factor.

[0026] Moreover, since the maximum-temperature position of a system can be made to always exist in the outlet side of an electrolysis cell 21 in order that a flow direction may not change, the heat transfer temperature gradient in heat regenerators 27 and 32 can be kept constant, and electrolysis-cell 21 inlet temperature can also be held to a maximum temperature and a certain fixed difference. Consequently, the temperature change of the electrolysis cell 21 by operation change does not arise, but there is no generating of repeat thermal stress, and it contributes to improvement in endurance.

[0027] Since similarly the maximum-temperature point in heat regenerators 27 and 32 and a minimum-temperature point can be fixed, without being dependent on an operation change, the thermal stress defatigation by temperature change can be mitigated, and reliability can be improved.

[0028]

[Effect of the Invention] As explained in full detail above, the power storage equipment with which it excelled in operability according to this invention, the thermal stress defatigation by generating and temperature change of repeat thermal stress was mitigated while operation was easy and could aim at curtailment of an operation factor, and improvement in reliability was achieved can be offered.

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ABSTRACT:

PURPOSE: To improve the operability in electrolysis and generation by setting the flowing direction of hydrogen or oxygen and steam supplied to steam electrolysis at electrolysis and generation in a fixed direction.

CONSTITUTION: In electrolytic operation, water is sent from a water tank 36 by a pump 37, mixed with a small quantity of hydrogen in the course of a hydrogen line, and supplied to a reversible electrolytic cell 21. The hydrogen manufactured by the electrolytic cell 21 and the unreacted steam are discharged from the outlet port of the electrolytic cell 21, the steam is condensed by a condenser 33 and separated into hydrogen and water. The hydrogen is pressurized by a compressor 34 and returned to a hydrogen tank 30. On the other hand, oxygen system is supplied to the electrolytic cell 21 in a fixed flow rate. The flow rate is increased in the electrolytic cell 21 outlet port at electrolysis, and the flow rate is reduced in the cell 21 outlet port lower than in the inlet port at generation. Thus, in both electrolytic mode and generating mode, hydrogen, oxygen and steam absolutely follow the same route.

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